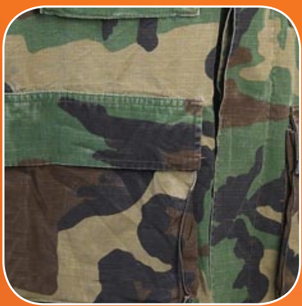
The imagination driving Australia's ICT future

NICTA



Case study:

Dynamic Planning Optimisation and Learning Project (DPOLP)

Dynamic Planning Optimisation and Learning Project

The challenge

Whether you're commanding an army, constructing a building or running an airline, having a well thought out operational plan is crucial for success.

As well as co-ordinating hundreds or even thousands of tasks, plans must take into account time frames, resources and budget parameters. Changes to any of these factors can have flow-on effects that can significantly alter the end result.

For years strategists and planners have used a combination of manual systems and scheduling software applications to assist with managing these complex sets of tasks. By plotting all tasks on a timeline and noting interdependencies, a project plan can be devised.

However such systems have a significant limitation as they are unable to take into account a factor that can have a greater impact than any other – uncertainty.

If a plan cannot be amended to factor in changing conditions or unexpected outcomes, its value to an organisation is greatly diminished. There is a need for a system that can deal with the factor of uncertainty and provide plans that will allow a group or organisation to reach their intended goal.

For example, an army may wish to secure an island, but what is the best way to achieving the aim? A mission plan must be able to factor in the probability of various activities succeeding, the effect of a myriad of external factors and the potential for unforseen events.

Creating such plans is no easy task. It requires considerable mathematical power and algorithms that can deal with thousands of different, interrelated tasks and factors.

The NICTA approach

In 2003 NICTA, together with a number of Australian universities, began working with the Australian Defence Science Technology Organisation (DSTO) to find ways to improve military planning methods.

Using a range of mathematical and scientific approaches, the NICTA team worked to develop planning approaches that would allow better use of military resources and increase the likelihood of operational success.

Researchers examined methods of dealing with the planning challenge that could be changed depending on the desired outcome. For example, plans could be tuned for completion in the minimum amount of time, for the lowest possible cost or for the best possible result.

When designing the planning applications, the NICTA team used various mathematical techniques including artificial intelligence and reinforcement learning.

As the number of tasks in a plan grows, the linkages between tasks increase exponentially. Before long the job of analysing the effect on the plan of a simple change to one task is well beyond human ability.

So, NICTA researchers used AI techniques to run millions of simulations of plans with slight variations to factors and tasks. Eventually the most efficient and effective plan can be identified.

Reinforcement learning techniques are also used. Here, a computer is rewarded when a particular plan variant results in a successful outcome. By trying multiple approaches and combinations of tasks, the computer can learn what is most likely to succeed.

Early examples of this technique were computerised backgammon games where software programs played against each other and developed successful strategies which were far from obvious.

The results

Although initially established as an academic program, designed to investigate theoretical planning methods, the DPOLP program has produced some notable successes.

Three software applications have been developed which take different approaches to the challenge of allowing for uncertainty in the planning process.

One has been designed to provide a recommendation on the best approach to take for a given project that will most likely result in success. Because of the nature of the mathematics involved this application is best suited to smaller projects where the number of variables is limited.

The other applications are designed for larger projects. While they cannot guarantee to provide the best approach, researchers are confident they provide better results than those possible with existing software or manual processes.

The software applications recently won first and third places in the International Probabilistic Planning Competition.

Commercialisation opportunities

While the software applications are still some way off becoming commercial products, the potential for the technology is significant.

The DSTO is watching development closely as there is acknowledgement that the techniques could significantly improve the efficiency of military operations.

Other potential areas of application include logistics and transportation companies facing the challenge of co-ordinating large equipment fleets in the most effective way.

For example, an airline operator could use the software to fine tune flight schedules or quickly amend them to overcome delays or breakdowns. Having an interactive application where changes to tasks or external factors can quickly be reflected in an overall plan could provide significant competitive advantage.

NICTA will continue to look for other commercialisation opportunities throughout the life of the DPOLP program.

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